(*Psophia viridis*) from the Amazons, two White-necked Storks (*Dissura episcopus*) from Africa, two Dusky Francolins (*Pternistes infuscatus*) from British East Africa, a Madagascar Tree Boa (*Corallus madagascariensis*) from Madagascar, purchased; two Red and Yellow Macaws (*Ara chloroptera*) from South America, received in exchange; a Hybrid Zebra (between *Equus caballus*, ♂, and *Equus burchelli*, ♀), a White-tailed Gnu (*Connochœtes gnu*, ♂), two Thars (*Hemitragus jemlaica*, ♂ ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in July:—

July 3. 8h. 57m. Partial eclipse of the moon. Magnitude 0·934.
4. Wolf's comet due at perihelion.
13. Venus 1° north of α Leonis (Regulus).
15. Venus. Illuminated portion of disc 0·765.
15. Mars. ,, ,, ,, 0·904.
15. Jupiter. Polar diameter, 31″·9.
15. Saturn. ,, ,, 16″·6.
16. 6h. 31m. to 9h. 25m. Transit of Jupiter's Sat. III.
18. 8h. 7m. Annular eclipse of the sun invisible at Greenwich.
18. Wolf's comet 27′ distant from Mars.
19. Saturn. Outer minor axis of outer ring, 17″·89.
26. 22h. 0m. Mercury nearly occults α Leonis (Regulus).
28. 12h. 49m. Moon in conjunction with α Scorpii (Antares).
28. Many meteors from Aquarius and Perseus.
30. 7h. 31m. to 8h. 41m. Occultation of λ Sagittarii (mag. 3·1) by the moon.

Comets that are now Visible.—There is plenty of cometary news in the three most recent numbers of the *Astronomische Nachrichten* (3498–3500). As regards comet Coddington-Pauly, which has a declination too southern for the ephemeris to be of any use in this column, Prof. Berberich publishes some new elements (*Astr. Nach.*, No. 3500) based on other observations than those previously used by him, which differ somewhat from the values given in his first computation. The comet has a southerly movement, so that it will not be visible in our latitude.

Comet Perrine (June 14), on the other hand, has a great northerly declination, and is increasing in brightness very rapidly. The elements and ephemeris of this comet have been computed by Perrine and Aitken, and also by Berberich. The elements obtained by the former we published last week, but they differ slightly from those calculated by Berberich, these being as follows:—

$$T = 1898 \text{ August } 4{\cdot}7473 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \omega &= 235^\circ\ 16'{\cdot}77 \\ \Omega &= 252\ \ \ 2{\cdot}34 \\ i &= 72\ \ 11{\cdot}43 \end{aligned}\right\} 1898{\cdot}0$$

$$\log q = 9{\cdot}44405$$

The ephemeris for the current week, according to these values, is:—

Ephemeris for 12*h. Berlin M.T.*

1898.	R.A. (app.) h. m. s.	Decl. (app.) ° ′	log *r*.	log Δ.	Br.
June 30	5 4 3	+52 57·9			
July 1	9 56	52 23·3	9·9817	0·2061	2·34
2	15 46	51 46·9			
3	21 34	51 8·7			
4	27 19	50 28·7			
5	33 1	49 46·7	9·9415	0·1904	3·03
6	38 40	49 2·7			
July 7	5 44 15	+48 16·7			

The new comet discovered by Giacobini is gradually decreasing its southern declination, but the elements at present calculated are described as uncertain. With a diameter of 2′, an excentric condensation, and of about the 10th magnitude (June 21), the comet is not an easy object. Those wishing to observe it will find the following positions useful.

Ephemeris for 12*h. Berlin M.T.*

1898.	R.A. (app.) h. m. s.	Decl. (app.) ° ′	Br.
June 29	18 5 48	−21 36·2	1·35
July 3	17 8 1	19 28·6	1·22
7	16 20 13	16 47·2	1·01
11	15 43 37	−14 11·4	0·79

The First Satellite of Jupiter.—In two early numbers of *Astronomy and Astrophysics* (November 1894 and May 1893) our readers may remember that Prof. W. H. Pickering contributed an account of a very interesting series of observations on the shapes of the satellites of Jupiter, and the conclusions he arrived at were that the discs were by no means round, but assumed very decided irregularities as they performed their rotations. These satellites have been further minutely examined by Mr. A. E. Douglass during last year, and in the *Astronomische Nachrichten* (No. 3500) he describes what knowledge has been gained by the observations of the first satellite. These were made in Mexico, from February 18 to March 28, with the Clark 24-inch, and in Flagstaff from May 16 to June 9. We must confine ourselves to a very brief summary of this paper, and refer our readers to the original for the minute details given both in the text and accompanying plate.

Although the markings on the satellite were sometimes well seen, the observations were not numerous enough over a long period of time to effectively map and determine the period of rotation by tracing the succession of detail. Mr. Douglass adopted Prof. Pickering's method of observing the changes in the elliptical form of the satellite's disc. After an elaborate trial of several periods he was led to deduce a period of 12h. 25·8m. for the year 1897, a value not very different from that found by Pickering in 1892, namely 13 hours. Most peculiar are the markings on this satellite. Assuming the axis of the satellite to be perpendicular to the plane of its orbit, they appear to extend from about + 60° to − 60° in latitude, and they take roughly the form of lines directed either to the north or south pole. Their general distribution can be best described and their symmetry best illustrated, as Mr. Douglass says, "by saying that they nearly form portions of five great circles passing round the satellite."

The micrometer measures for determining the elliptical form of the disc gave indications of a large ellipticity. Mr. Douglass thinks that this flattening is real, and not due to the presence of surface markings near the limb. The following brief table shows the values of the ellipticity and period of rotation for the periods observed since 1892:—

Date.		Ellipticity.	Period. h. m.	Obs.	Telescope
Dec.	1892	100-110	13 3	Pickering	13 inch
Oct.	1894	108–120	13 3	,,	18 inch
March	1895	104–120	(?)	Douglass	,,
March	1897	115–130	12 25·8	,,	24 inch

The indications of an increase in the ellipticity and decrease in the period of rotation led Mr. Douglass to investigate the question of whether a decrease in the size of the disc had been observed. An examination of the existing measures showed that such a change has probably taken place, but the values cannot be relied on for certain. If this decrease in size be an actual fact, then the increase in rotational velocity and increase in mean polar compression would naturally follow.

The Meteor Shower of November 13, 1897.—Those who intend to systematically observe or photograph the meteor shower next November, will find in the account of the arrangements made last year at the Harvard College Observatory (*Annals*, vol. xli. No. 5) many interesting suggestions. Prof. W. H. Pickering, as will be gathered from his description in the above-mentioned *Annals*, made arrangements for a combined attack on the night of the 13th at various stations connected with the observatory. To present an idea of the scale in which such work is undertaken in America, in addition to visual observations, we give the number of plates exposed and instruments used. Three plates were taken with the Draper 11-inch telescope, with two objective prisms of 15°. Fourteen plates with the 8-inch, with two objective prisms of 6° each. Twelve plates with the 6-inch, with objective prism of 6°. Eight plates with a Voigtländer 5-inch, with an objective prism of 6°. Three plates with a Ross rapid rectilinear lens of 1·5 inch, angle of prism 15°. With such a collection of fine instruments at work, it was only too disappointing that the meteors were so few and faint;

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but it is consoling to think that the experience gained that night will undoubtedly be used to render the work at the time of the next November meteor shower more efficient. As regards the best form of lens to employ, Prof. Pickering advocates "a portrait lens of the kind formerly used by photographers." The plates should be exposed for half an hour, and at the end of this time the camera should be again pointed to the region fifteen minutes preceding the radiant point. At the Solar Physics Observatory, at Kensington, the methods employed were to fix a camera on the tube of a large equatorial (near the object-glass end), and also on the hour-angle circle of a siderostat, both cameras being moved by the clock-work of each instrument. Other cameras were fixed and oriented towards the radiant point and other directions. The 9-inch equatorial with objective prism was also used, but no bright meteor, unfortunately, passed across the field. May the meteorological conditions be such that the meteor shower of November 1898, will be well observed and successfully photographed!

HIGH SPEED TELEGRAPH TRANSMISSION BY MEANS OF ALTERNATORS.

ALTHOUGH, at the present day, high speed transmission is much more limited in its application than at an earlier period in the history of telegraphy, owing to the commercial aspects of the question having been unavoidably altered, attempts have been made from time to time to produce improvements in this direction; but until lately the admirable system invented by the late Sir Charles Wheatstone, and considerably improved by the British Post Office Telegraph Administration, has been the best available method of automatic high speed signalling.

The speed at which a series of waves can be passed over a given line depends primarily and inversely upon the product of the total resistance into the total capacity, the form of the wave having a considerable influence on the speed where any measurable capacity is present.

In the ordinary Wheatstone automatic fast speed system of telegraphy, the letters are formed by waves of different duration, a dot being produced by a short wave, a dash by a longer one. This renders it necessary to charge the line longer for a dash than for a dot, which is a grave defect in fast speed working; but the condenser compensation, introduced and employed by the British Post Office, practically doubles the speed attainable on any given line by, in some measure, equalising the line charges. That is to say, the condenser used is always of a capacity which admits of a full charge during the time interval of a dot, and a current of the duration of a dash does not give the condenser any higher charge. Indeed condenser compensation has such a beneficial effect, that the defect of unequal impulses is almost overcome, inasmuch as the increase of speed obtained by this arrangement and equal impulses, is only 5 per cent. greater than that obtained with currents of unequal duration. Again, although the signals be made equal in this system, another difficulty presents itself; that is, the waves that are sent through the line are the results of the sudden applications of the full E.M.F. used (in practice 100 volts), and consequently a reversal means a sudden change of 200 volts, *i.e.* from 100 volts positive to 100 volts negative. The form of the current wave with such a system depends almost entirely on the nature and form of the circuit. It is easy to produce correspondingly sudden and complete changes in the current when the circuit possesses only resistance, but when capacity, &c., is present, the form of current wave is vastly different to the impressed E.M.F. wave; for example, take the letter "A," the actual current curve on a land line without condenser compensation is shown in Fig. 1, while Fig. 2 represents the effect of shunted condenser compensation.

Prof. A. C. Crehore, of Dartmouth College, U.S.A, in conjunction with Lieut. G. O. Squier, of the United States Artillery, have, however, been led to make some experiments with alternators, and have suggested a mode of high speed signalling which, although presenting some mechanical difficulties, has recently been tried by the inventors of the Post Office telegraph lines in England, under the direction of Mr. Preece, and found to produce a distinct increase of speed.

Fig. 3 shows an ordinary sine wave as produced by an alternator, and it is this form of wave that Messrs. Squier and Crehore use in their so-called "synchronograph" system of fast speed telegraphy.

The signals are obtained by the omission of certain complete cycles or semi-cycles, the message being read by means of the blanks in the regular succession of recorded dots; or signals can be recorded on chemically prepared paper.

This system is to some extent a synchronous one with this great advantage over the many well-known synchronous systems, that the synchronism is not required between the transmitter at one end and the receiver at the other end of a line, but between the alternator and transmitter at the sending end of the line. This is easily obtained by driving the transmitter from the generator shaft. The transmitter itself is exceedingly simple, and consists of a wheel the circumference of which is one continuous conductor, presenting a smooth surface for the brushes to bear upon. If the periphery of this wheel be divided into forty equal parts, and be geared to run at one-fourth the speed of the armature of a ten-pole alternator, clearly one of these equal parts will correspond to one semi-cycle of E.M.F. produced by the alternator. Upon the surface of the wheel bear two brushes, carried by an adjustable brush-holder. One brush is joined to the generator, and the other to the line, so that the current entering one brush from the generator passes across the transmitting wheel to the other brush, and thence out to the line.

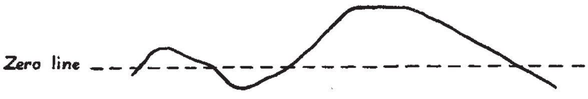

FIG. 1.

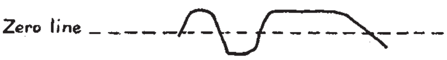

FIG. 2

Now if a piece of paper $\frac{1}{40}$ of the circumference of the wheel be fixed thereon in such a position as to pass under one of the brushes, one semi-cycle or half-wave of current will be omitted in every twenty complete waves, and by means of a suitably prepared paper ribbon, or "slip," any combination of signals can in this simple manner be transmitted. The brushes are adjusted so that the periods of disconnection and connection coincide with the zero points of E.M.F. The transmitter may, however, have only one brush joined to line, and the wheel itself may be made the connection to the generator. With this mode of signalling much higher E.M.F.s may be used, and connections and disconnections made almost without spark at the brush contacts.

The speed of the transmitting wheel with respect to the generator shaft is immaterial, the essential being that its circumference should contain an integer number of times the arc which a point fixed with respect to the field would describe on such circumference during one semi-period of current.

FIG. 3.

Complete control of every semi-cycle of current thus permits the maximum speed of transmission of signals with a given frequency. If the transmitter does not act in synchronism with the generator, the "make" and "break" of the circuit occurs when the current is not naturally zero, and considerable interference results; care is, therefore, taken to ensure that the "slip" admits of the line connections being made at the proper times only.

Although the received signals were originally intended by Messrs. Squier and Crehore to be recorded on chemically prepared paper, they have also devised a very ingenious massless receiver, although at present it is not in a practical form. It is based on the well-known discovery of Faraday that a beam of polarised light may be rotated by means of a magnetic field, the direction of rotation of the ray being the same as the direction of the current producing the field; the rotary power depends upon the intensity of the magnetic field, and the total amount of rotation upon the length of the rotary medium in which this magnetic field exists and through which the ray passes.

The method adopted is to pass a beam of light through a

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